3.) Use the data stream multiple times (since the signal is oversampled) within a bit period to correlate it with multiple phases of the bit sequence that is being searched for. In certain cases, for example, one or more accumulators can be used to keep these multiple correlation results in real time, when the signal samples are not otherwise stored;

4.) Determine if the synch word is currently present in the signal sample stream and complete an interpolation of the maximum and adjacent correlator outputs to determine the exact phase of the synch word, for example, using a peak detector with an appropriate threshold criterion; and

5.) Combining the resulting phasing with appropriate clock data to assign a time of arrival for the first edge of the synch word (or center, if desired).

The modified GPS receiver or signal processor, in this example, simultaneously searches for the synch word in bit positions with a resolution of a fraction of a bit. In the case of GSM, for example, ten (10) physical correlators can be used to look for the 26 bit synch word. The resolution would then be about ¼ of a bit; that is, there would be four (4) phasings within a bit, which would produce a total of about 150 simultaneous correlations to occur in real time on the input signal sample stream. Because of this oversampling in bit space, additional equalization will probably not be required in such a GPS receiver or signal processor.

Such a configured or modified GPS receiver or signal processor would have the further ability to perform appropriate doppler shifts on the sampled data to remove loss that would occur if the sampling frequency was not exactly related to the signal frequency. A good starting estimate of doppler can be obtained from a strong signal transmitted from the BS **20** that MT **64** is communicating with, for example.

In the examples above, the digital processing is actually run at about 48 times the normal bit rate. For GSM, this proves to be very convenient, as 48 times the bit rate is about 13 MHZ. The IF would be converted to about 12.64 MHZ and the sample rate would be about 10.1 MHZ.

To better illustrate these exemplary frequency conversions and correlation functions and associated advantages, an exemplary portion of a modified GPS receiver **70** is depicted in FIG. **9**, for use in a mobile terminal, such as, MT **64**. Modified GPS receiver **70** includes a frequency converter **72** that is configured to receive and down frequency convert a GSM signal and provide a corresponding down converted GSM signal to a GPS correlator **74** (for example, within a signal processor). GPS correlator **74** is configured to detect signal features from both the modified GSM signal and a conventional GPS signal, and to provide appropriate outputs.

FIGS. **10** and **11** provide additional details, in the form of an exemplary modified GPS receiver **100** and an exemplary modified homodyne GPS receiver **100'**, respectively. Receiver **100** receives a GSM signal from a GSM front-end **102**. Front-end **102** can, for example, include a conventional GSM controller unit, processor, transceiver, etc. The GSM signal is received through a SAW interference filter **104** and frequency converted (down) by multiplier **108**. Then, the resulting frequency converted signal is filtered by LC filter **110** and then sampled or quantitized using buffer **112**, A/D converter **116**, an FIR band pass filter (BPF) **118** to produce 2-bits in accumulator **120**. The digital output from accumulator **120** is provided to a GPS baseband (BB) correlator **114** which provides correlator outputs and/or peak detector outputs. Receiver **100** preferably has a high IF. This high IF signal is preferably tapped off early in the circuitry chain, so that the GSM signal will be significantly linear going into A/D converter **116**.

Because of the oversampling rate, and the reduced amount of interference resulting from SAW interference filter **104**, the A/D resolution may be less in certain configurations, as determined by the C/I ratio. Further, by providing four (4) samples per bit, there is a minimal residual slow rotation in the sampled output stream (e.g., as in the GPS case with only 2 samples per chip).

Similarly, in FIG. **11**, modified homodyne GPS receiver **100'** receives a GSM signal from GSM front-end **102**. The GSM signal is received through a low pass (LP) filter **130** and the resulting lower frequency signal is then sampled or quantitized using buffer **112**, A/D converter **116**, an FIR BPF **118** to produce 2-bits in accumulator **120**. The digital output from accumulator **120** is provided to GPS BB correlator **114** which provides correlator outputs and/or peak detector outputs.

As depicted in FIG. **12**, the 10.1 MHZ sampling clock provided to A/D converter **116** in FIGS. **10** and **11** can be derived from the 13.0 MHZ signal with an integer phase locked loop **140**, wherein a ratio of the system clock to sample clock is 9 to 7. Thus, the exemplary integer phase locked loop **140** includes a divide by nine (9) block **142** that receives the 13.0 MHZ signal, and a divide by seven (7) block **148** in the feedback loop, each of which provide inputs to multiplier **144**. The output of multiplier **144** is provided through filter **146** and then output for use, and feedback.

Although some preferred embodiments of the various methods and arrangements of the present invention have been illustrated in the accompanying Drawings and described in the foregoing Detailed Description, it will be understood that the invention is not limited to the exemplary embodiments disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from the spirit of the invention as set forth and defined by the following claims.

What is claimed is:

1. A method comprising:

receiving at least one first type of signals from at least one satellite using a mobile terminal;

receiving at least one second type of signals from at least one terrestrial transmitter using the mobile terminal;

measuring a time of flight for each of the first type of signals;

measuring a time of flight for each of the second type of signals;

converting each of a resulting time of flight measurements associated with each of the first type of signals to a corresponding first type of range value;

converting each of a resulting time of flight measurements associated with each of the second type of signals to a corresponding second type of range value; and

determining an approximate position of the mobile terminal using at least one first type of range value and at least one second type of range value.

2. The method as recited in claim **1**, wherein the at least one satellite is part of a Global Positioning System (GPS).

3. The method as recited in claim **1**, wherein the terrestrial transmitter is part of a mobile telecommunications system having at least one base station therein, and the second type of signal includes a downlink transmitted signal from the base station.

4. The method as recited in claim **1**, wherein each of the steps of measuring the time of flight for each of the first type